REMARKS

By the present amendment, the specification has been amended to correct minor typographical errors. Claims 1-33 are pending. Applicants note with appreciation the allowance of claims 6-11 and 22-24 if rewritten in independent form. Applicants defer presenting these claims in independent form until the Examiner has had an opportunity to consider the following remarks regarding the base claims 1 and 17.

In the Office Action, claims 1-5, 12-21 and 25-33 are rejected under 35 U.S.C. 103(a) as being obvious over U.S. Patent No. 6,014,904, to Lock (hereinafter referred to as the Lock patent) in view of U.S. Patent No. 6,317,517, to Lu (hereinafter referred to as the Lu patent). The Applicants respectfully traverse this basis for rejecting the claims.

The present invention relates generally to a method for identifying clusters in two-dimensional data. In the present methods, a density estimate is first determined from the two-dimensional data and the clusters are identified from the density estimate. Independent claims 1 and 17 are drawn to a preferred embodiment in which a two-dimensional histogram is generated having a select number of bins in each dimension, and the density estimate is determined from the two-dimensional histogram. As stated in paragraph [0038] of the present application, binning the data is advantageous because it reduces the number of processing steps needed to create the density estimate.

Applicants wish to point out that the dimension of a histogram refers to the number of data variables depicted, rather than the total number of dimensions used to depict the histogram. For example, a one-dimensional histogram is a representation of one-dimensional data in which data values are plotted along one axis (e.g., the x-axis) and the frequency of each data value is plotted on a second axis (e.g., the y-axis). Thus, although the histogram is plotted in two dimensions, the underlying data are one-dimensional and the histogram is referred to as a one-dimensional histogram. Similarly, a two-dimensional histogram, as shown in Fig. 5 of the present application, is a plot of two-dimensional data (the data values varying on the x and y axis), wherein the frequency of each value is depicted on a third axis (e.g., the z-axis).

In contrast to the two-dimensional histogram generated in the method of independent claims 1 and 17, the Lock patent cited against claims 1-5, 12-21 and 25-33 discloses only processing of one-dimensional histograms such as the one-dimensional

histogram illustrated in Fig. 3B therein. This one-dimensional histogram comprises bins on the domain of one variable CD45, that is, bins along the x-axis. The exemplary two-dimensional histogram in Fig. 5 of the present application has, on the other hand, bins in both the x-direction and the y-direction to represent two variables (e.g., CD45 PerCP and side scatter), as described in paragraph [0037].

Independent claims 12, 25, and 29 are drawn more generally to the invention in which the density estimate is generated from the two-dimensional data. Claims 12, 25 and 29 each recite the use of density estimates to identify at least one cluster in two-dimensional data, and determination of a boundary around the cluster, wherein the points in the cluster satisfy a selected density criteria, among other features. A density estimate is an estimate of the typically unknown probability density function from which the data were generated. A density estimate adds a third dimension, z, to the two-dimensional data whereby the value of z varies with the frequency or density of the (x, y) data pairs. The resulting density estimate can be visualized in a three-dimensional plot as shown in Fig. 3 of the present application. The peaks in the graph of Fig. 3 correspond to high values of z and are located in areas where there is a high frequency of (x, y) data pairs. The valleys and low, flat areas in the graph of Fig. 3, that is, the places where z is low, correspond to places where (x, y) data pairs are sparse.

The Office Action states that the Lock patent purportedly teaches generating a two-dimensional histogram. The Office Action further states that Fig. 3B of the Lock patent has an x-axis and a y-axis and that the histogram in Fig. 3B has bins in the x and y directions. The bins disclosed in the Lock patent, however, are only in the domain of one variable and are depicted along only one axis (e.g., the x-axis). The y-axis merely denotes a frequency measure of the value of the single variable. There is no disclosure in the Lock patent of processing two-dimensional histogram data such as that depicted in Fig. 5 of the present application, which depicts bins along both of the x and y axes and a third axis (i.e., z-axis) to represent the frequency measures of the two variables represented along the x and y axes of the two-dimensional histogram.

In the Office Action, the Lu patent is relied on for its disclosure of Gaussian kernels for density estimation. The Applicants respectfully submit that the Lu patent does not overcome the deficiencies of the Lock patent. Further, the Lu patent discloses

the use of the kernels for all elements of the data being analyzed. Column 3, lines 40 and 41 state that a smoothing parameter "characterizes the radius of influence *of each element of the data*" (emphasis added). Thus, the Lu patent discloses a density estimation method requiring operation(s) on every point in a data set and therefore a method that is sought to be avoided by the present invention. As stated in paragraph [0038] of the present application, density estimation methods that operate on all points in a data set place a significant burden on the processor when analyzing flow cytometry samples. By contrast, the present invention recited in claims 1 and 17, for example, preferably only operates on the histogram bin counts.

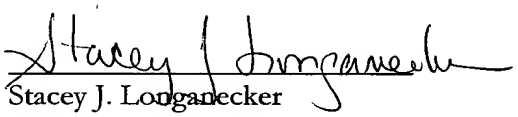
Accordingly, neither the Lock patent nor the Lu patent singly, or in combination, discloses or suggests the claimed invention. Independent claims 1 and 17 both recite generation of a two-dimensional histogram characterized by a grid having an x-axis and a y-axis and a selected number of bins in the x-direction and a selected number of bins in the y-direction, among other aspects of the invention. Neither the Lock patent nor the Lu patent singly, or in combination, discloses or suggests generation of a two-dimensional histogram. As stated above, the Lock patent only describes a one-dimensional histogram, and the pattern recognition method of the Lu patent does not employ histograms of any kind. Further, claims 1 and 17 both recite determining a density estimate based on bins. The Office Action acknowledges that the Lock patent does not disclose determining a density estimate. The Lu patent, on the other hand, discloses only use of density estimate on every data point or element, and not on bins. Thus, the Applicants respectfully submit that the combination of the Lock patent and the Lu patent does not render claims 1 and 17 obvious, and respectfully request withdrawal of this basis for rejecting claims 1 and 17 and their corresponding dependent claims 2-5 and 18-21.

Claims 12, 25 and 29 each recite the use of density estimates to identify at least one cluster in two-dimensional data, and determination of a boundary around the cluster, wherein the points in the cluster satisfy a selected density criteria, among other features. As stated above, the Office Action acknowledges that the Lock patent does not disclose determining a density estimate. The Lu patent discloses pattern recognition whereby feature selection is performed on a set of data to determine a selected feature, and then

the set of data with the selected feature is used to determine a recognized pattern. The Applicants respectfully submit that the Lu patent does not disclose or suggest the use of density estimation for identification of clusters in data. The feature selection in the Lu patent is on the basis of a Classification and Regression Tree (CART). By contrast, identification of clusters does not employ a recognized pattern, but rather identification of any grouping of points satisfying a selected density criteria. Accordingly, Applicants respectfully request withdrawal of this basis for rejecting claims 12, 25 and 29 and their corresponding dependent claims 13-16, 26-28 and 30-33.

In view of the above, it is believed that the application is in condition for allowance and notice to this effect is respectfully requested. Should the Examiner have any questions, the Examiner is invited to contact the undersigned at the telephone number indicated below.

Respectfully Submitted,



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Dated: August 24, 2004